**Sustainable Development and Ethical Aspects of the frequency downconverter**

**Frequency downconverter**

**Description**

This project aims to design a frequency downconverter which is used to bring down the frequency of high frequency signal. Meanwhile, other characteristics of the signal will be preserved. This product can significantly lower costs because the output low frequency signal can be handled by other cheaper and more widely used components. Therefore, the frequency downconverter is important in signal processing equipment. This device consists of the filters and mixer circuit and the components are soldered in a Printed Circuit Board (PCB). Dring the manufacture process, soldering produces some fume which should be concerned in sustainability development.

**Regulatory consideration**

This section will discuss the sustainability of the product with regard to the relevant regulation. The use of hazardous substances (RoHS) is considered firstly.

According to theRestriction of Hazardous Substances (RoHS), the use of hazardous substance is restricted [1]. The material used in the products are conform to the standards. This product satisfies the restriction because every component is purchased from authorized supplier and satisfies the RoHS regulation.

Besides, according to Waste Electrical and Electronic Equipment Recycling (WEEE), the recycle method should be available to customers [2]. Customer can contact the professional recycle company which will be hired to recycle the e-waste. The contact and address of recommend recycle company will be available in the customer manual. Customers will also be reminded to separate the e-waste from other waste.

Finally, according to CE, products which are sale in the European Economic Area (EEA) should be proved to satisfy the safety, health and sustainability requirement [3]. Because the components are from the supplier with CE marking, the frequency downconverter satisfies the CE requirement.

**SD/Ethical Implication of large-scale manufacture and sale**

This section will provide an analysis of the ethical and sustainability development in large-scale manufacture and sale. On the one hand, the sustainability is challenging because this frequency downconverter consists of many electrical components. The large-scale manufacture of the frequency downconverter will also cost much mental and semiconductor resources. Moreover, the manufacture of semiconductor cost energy. On the other hand, the recycle of the product may cause some environment problems. The hazardous substance in the product may be released if the recycle process is not proper. The substance is possible to harm the health of the recycle worker. Meanwhile, the environment pollution is possible during the recycle process.

On the contrary, the frequency downconverter will benefit the society. It can reduce the cost of signal equipment. With a lower price, the communication might be easier and cheaper. It can make communication more accessible.

As for the ethical principle, this may have a negative impact on the security of information transfer. It might be used to eavesdrop information. Therefore, this product might be only offered to some partnership manufacture companies who are likely to obey the ethical principles. For example, the company with a better social reputation and strict ethical internal regulation is a preferred partner. The cautious choice of customer companies can ensure that the product will not be widely used for illegal purpose.

For the improvement, the engineer will try to design a simple circuit with less component. The smaller number of components can reduce the cost and reduce the e-waste.

**SD/Ethical Implication of follow-on products/markets**

This section will discuss the problem in follow-on products and markets. The new version of products can improve the accuracy of the signal output. In the next version, two filters will be used to remove the noise in the input signal and the output signal. Without the noise, the accuracy of signal will be improved by the approach. Therefore, the products can enter new markets which requires high accuracy. It can be used in more signal devices.

However, the new version of products also has a negative impact on the sustainability development. The quick improvement of the electrical device might cause the frequent replacement of signal device and produce much e-waste. It is challenging to recycle a large amount of e-waste. More resources are essential in the recycle of the e-waste. Otherwise, the e-waste may cause serious environmental problems.

In conclusion, follow-on products might benefit the customer. In the meanwhile, the potential environment protection risk should not be neglected.

**Reference**

[1] (2014, Apr. 15) *Regulations: restriction of hazardous substances (RoHS)* [Online]. Available: <https://www.gov.uk/guidance/rohs-compliance-and-guidance> [accessed 21 Feb 2020]

[2] (2014, Jan. 1) *Waste Electrical and Electronic Equipment recycling (WEEE)* [Online]. Available: <https://www.hse.gov.uk/waste/waste-electrical.htm>

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[3] *CE marking* [Online]. Available: <https://ec.europa.eu/growth/single-market/ce-marking_en> [accessed 21 Feb 2020]